

Institute of Neuroinformatics  
University of Zurich and ETH Zurich

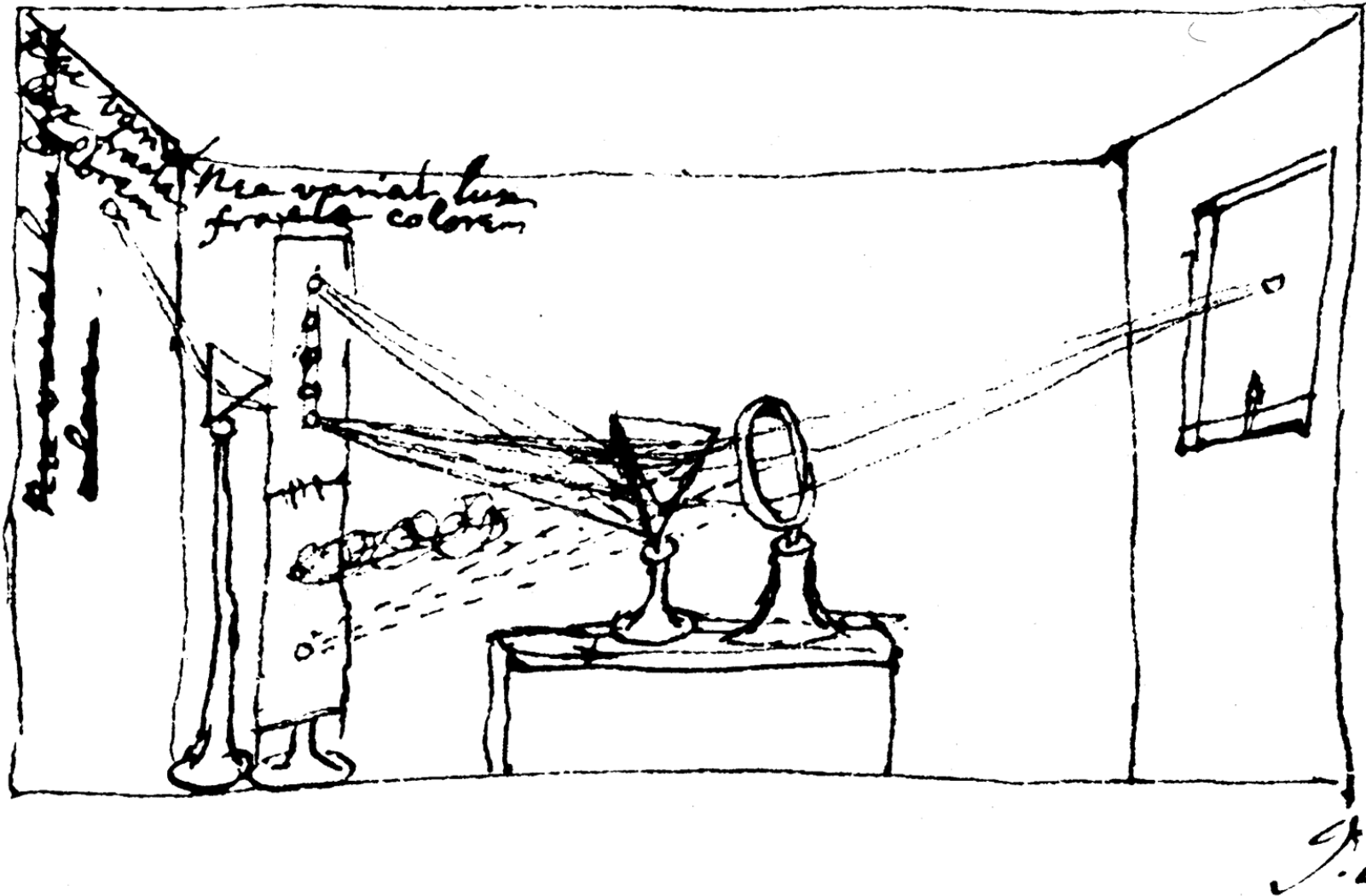
# **Computation in Neural Systems: Biological Vision**

**11.4.2024**

Daniel C. Kiper

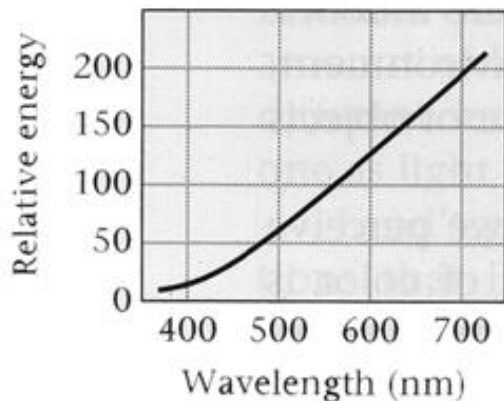
[www.ini.uzh.ch/~kiper/comp\\_vis/index.html](http://www.ini.uzh.ch/~kiper/comp_vis/index.html)

# Newton's experiment

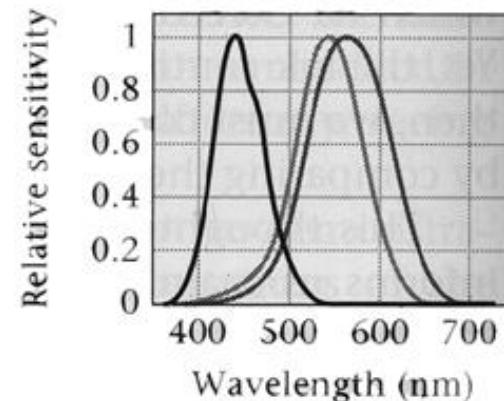


# Real life color perception

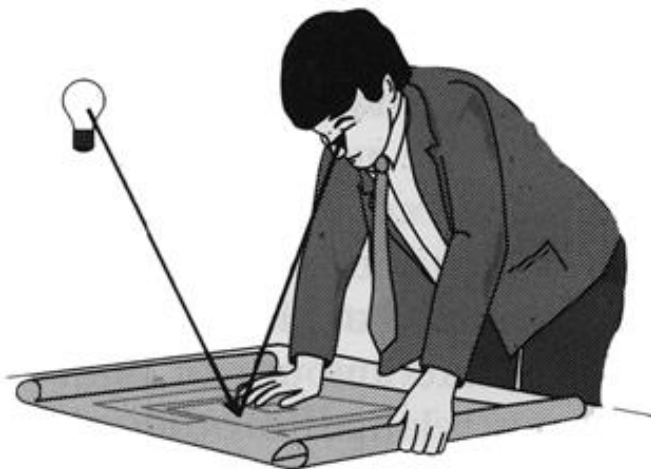
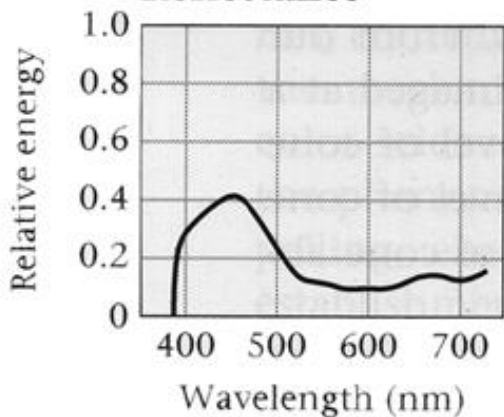
### Illumination



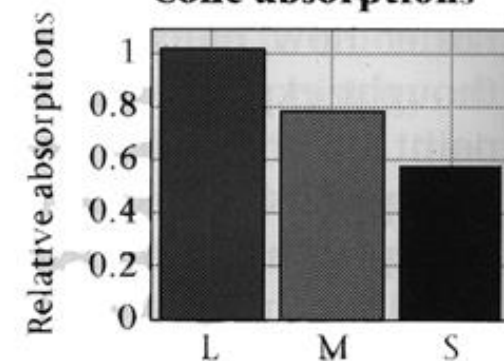
### Cone sensitivities



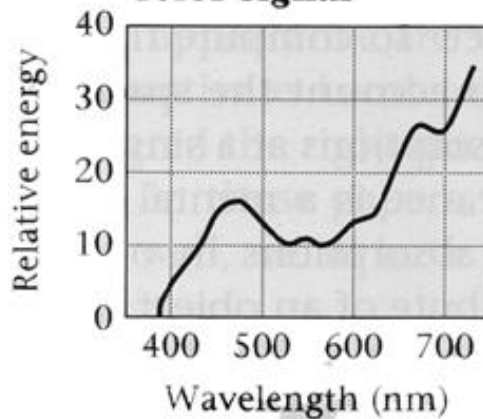
### Reflectance



### Cone absorptions

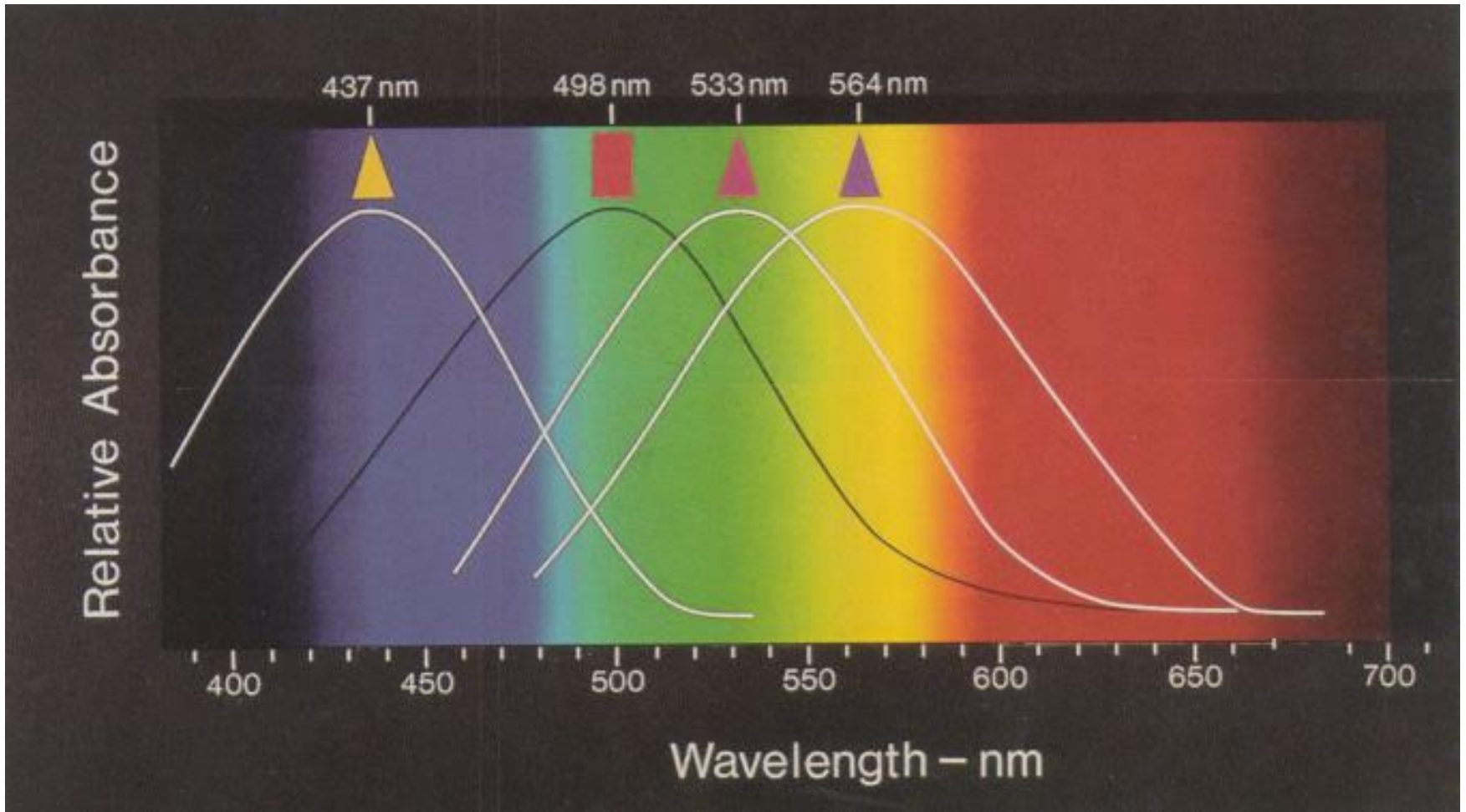


### Color signal



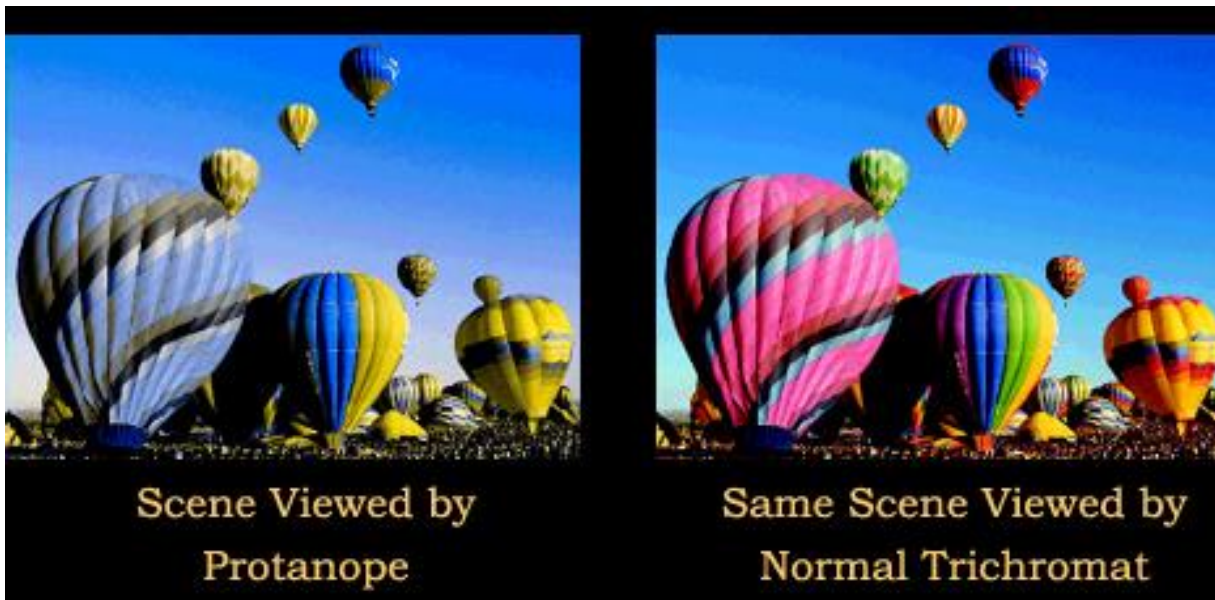
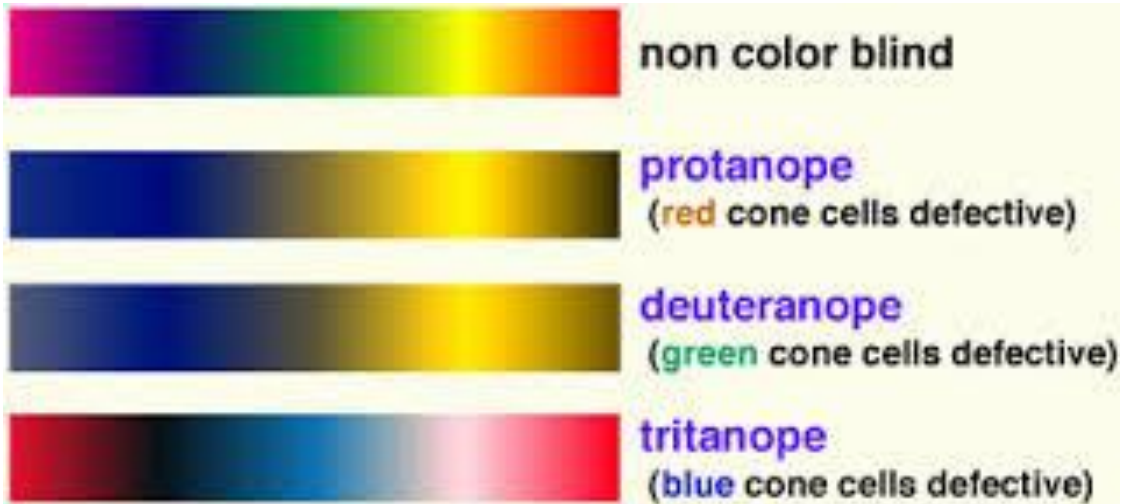
# Photoreceptors sensitivity profiles

S      Rods      M      L

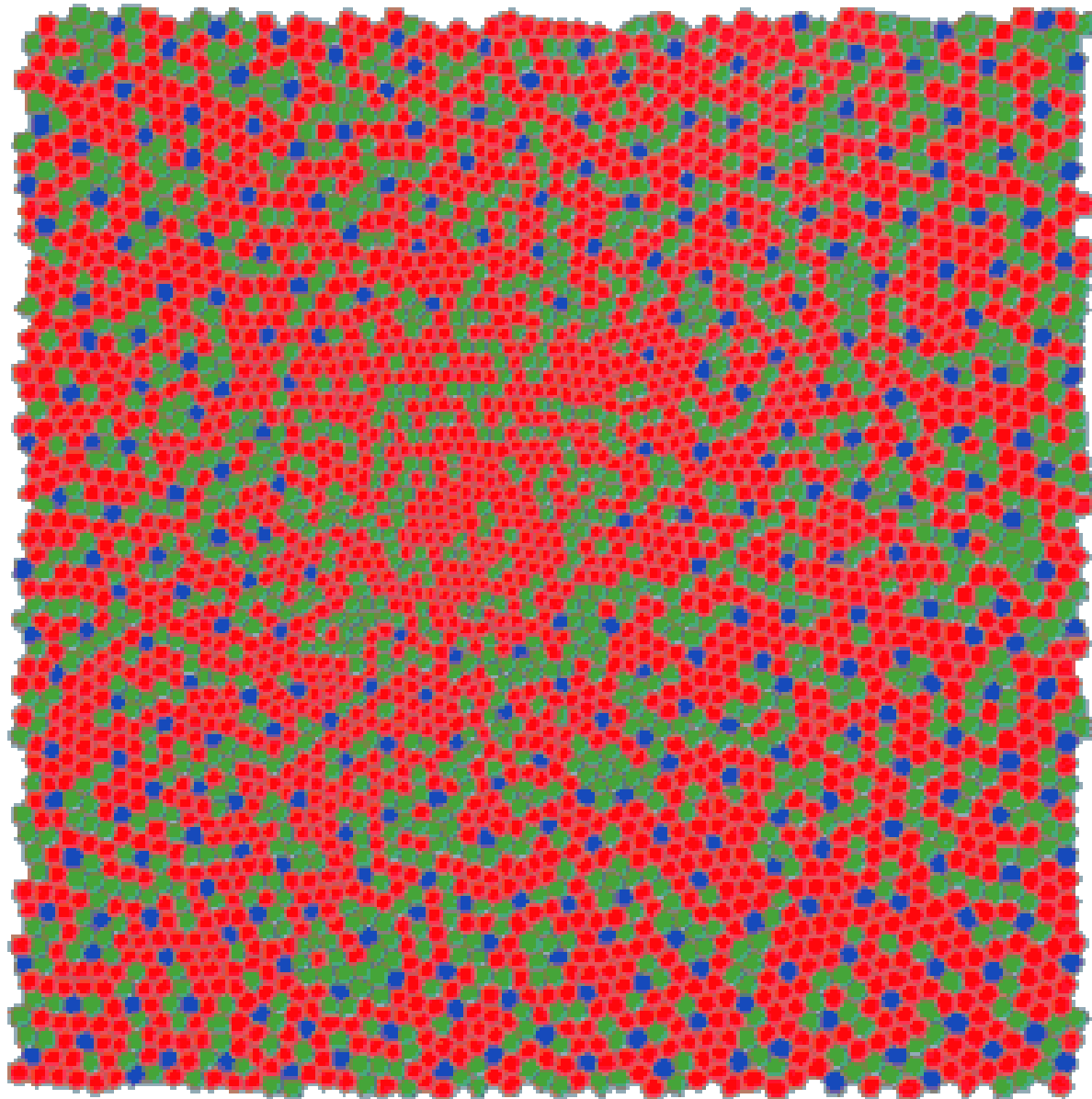




Sekuler and Blake, 1985, plate 6



## Cone mosaic



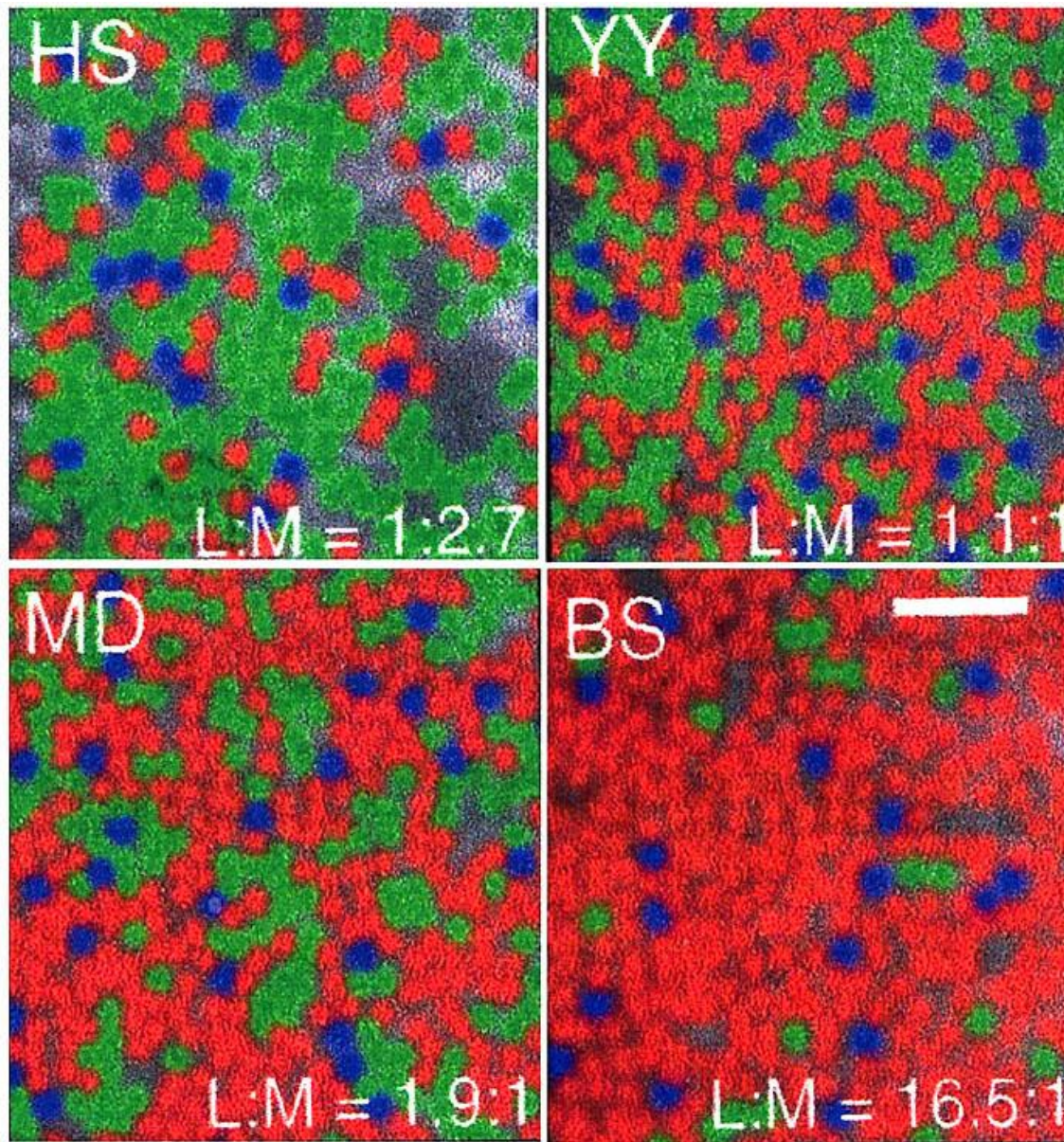
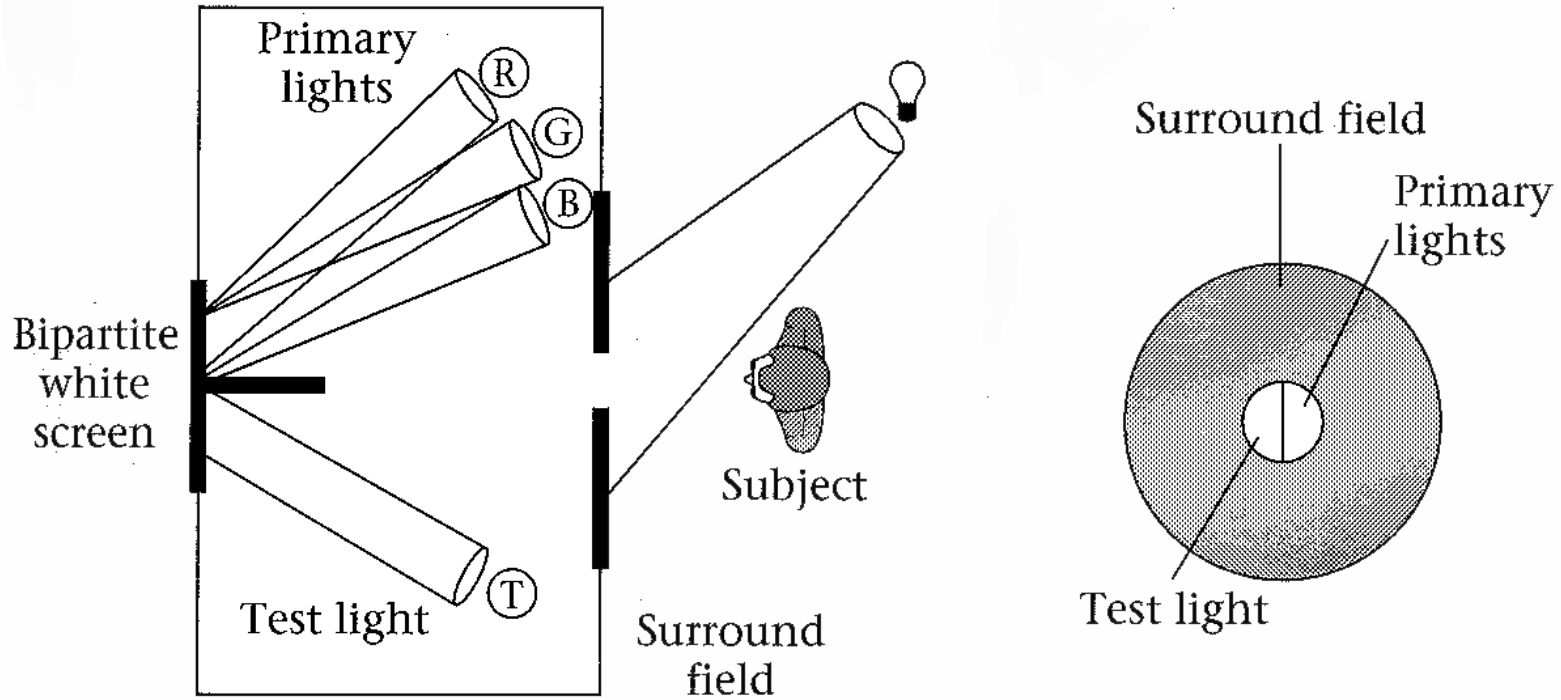


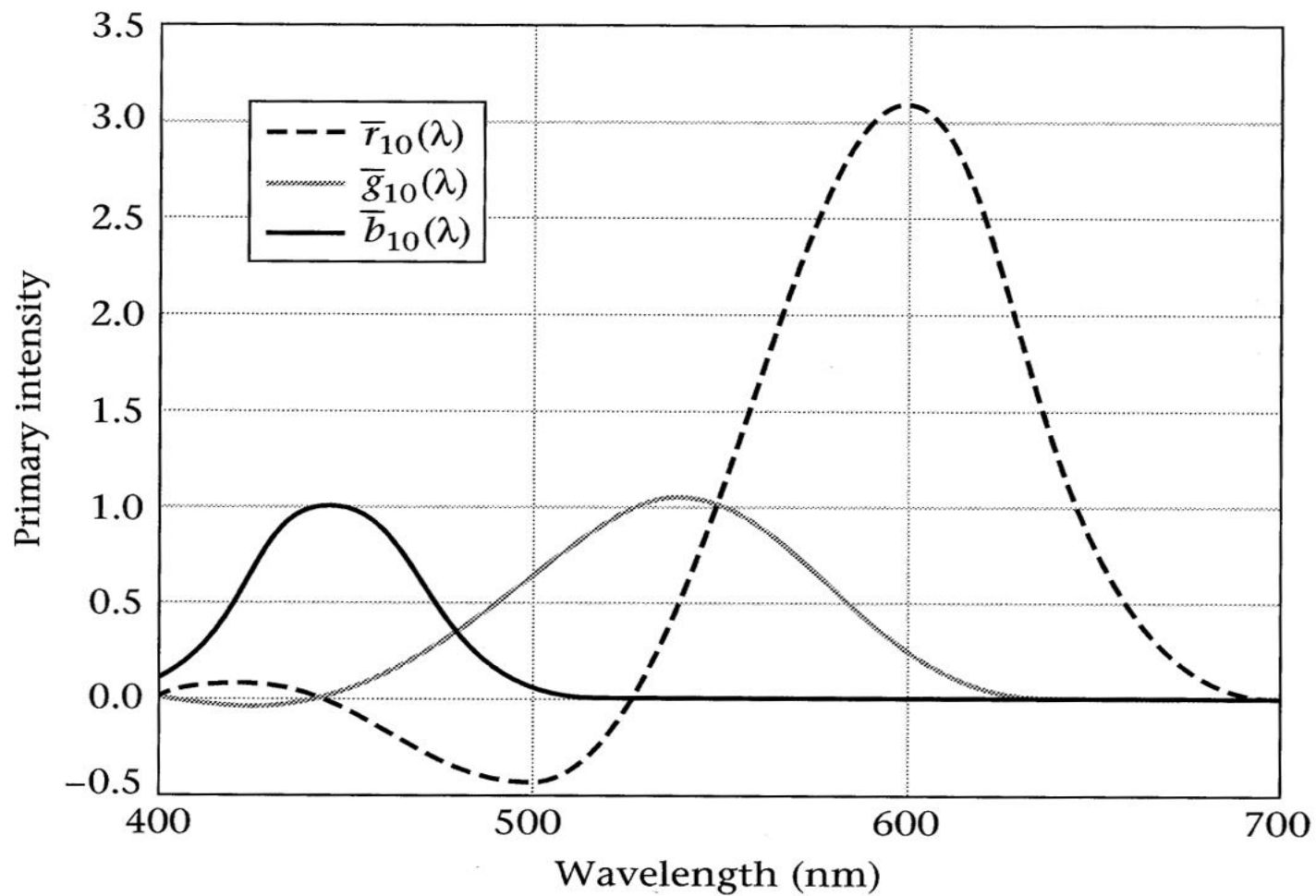
Fig. 21 shows an adaptive optics view of the mosaic of L (red), M (green) and S (blue) cones in four human subjects with normal color vision. The ratio of S to L and M cones is constant but that of L to M cones varies from 1:2.7 (M:L) to 16.5:1 (L:M). (adapted from Williams).



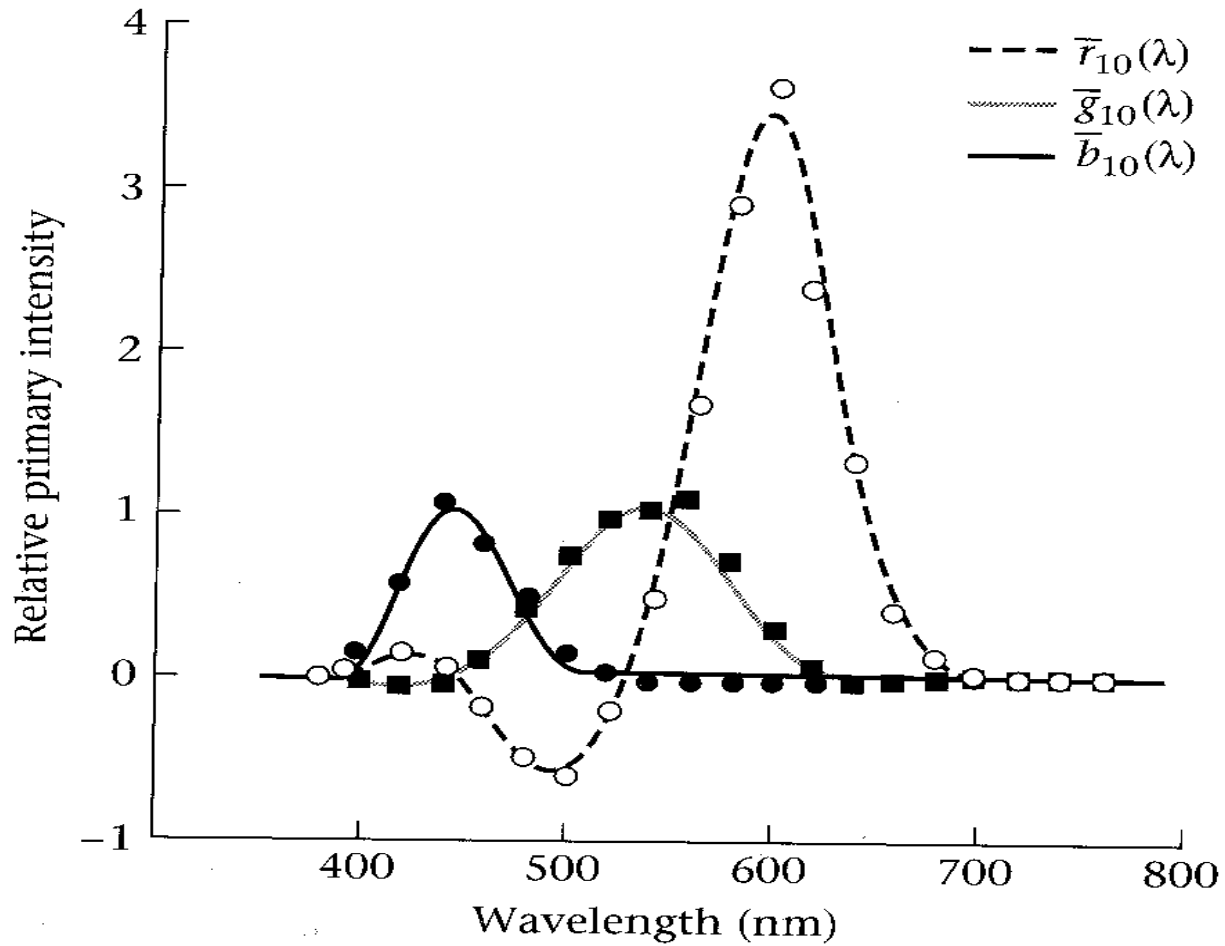
# Color matching experiments



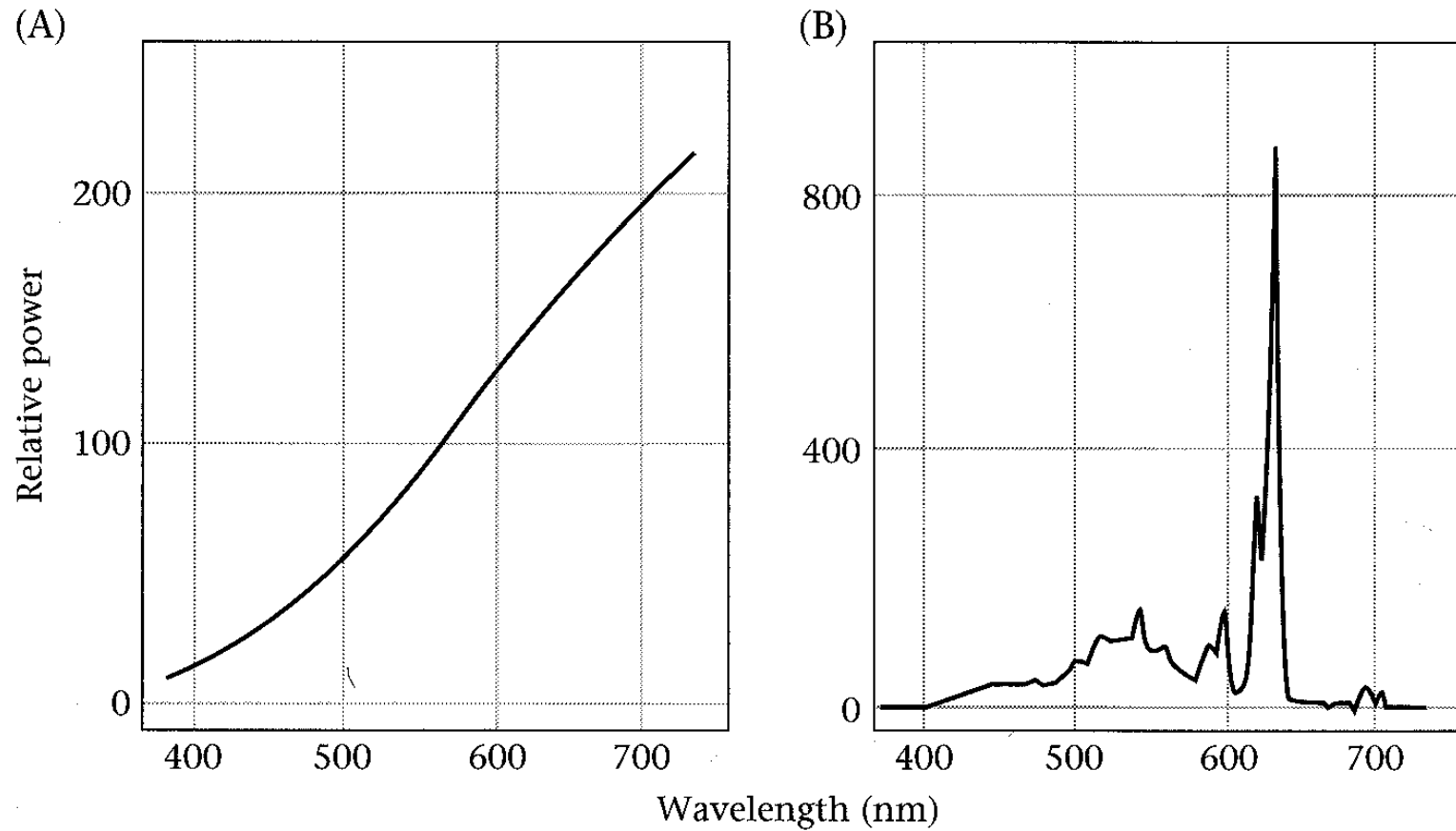
# Color matching: results



# Color matching: predictions vs. data



# Two metameric spectral distributions

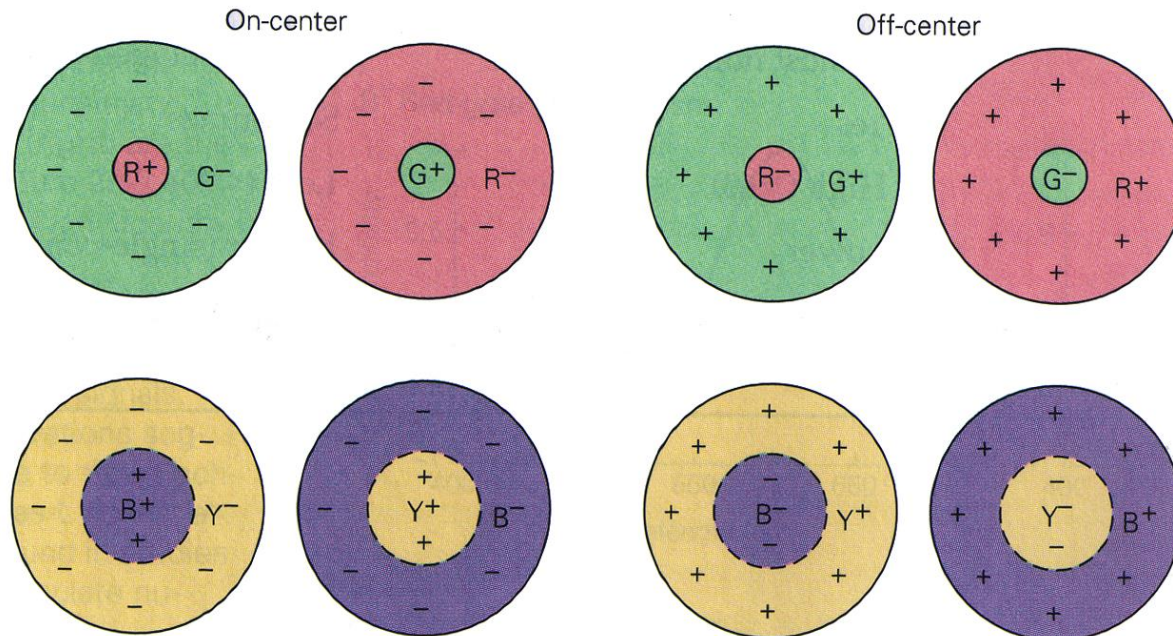


# Receptive fields of LGN neurones

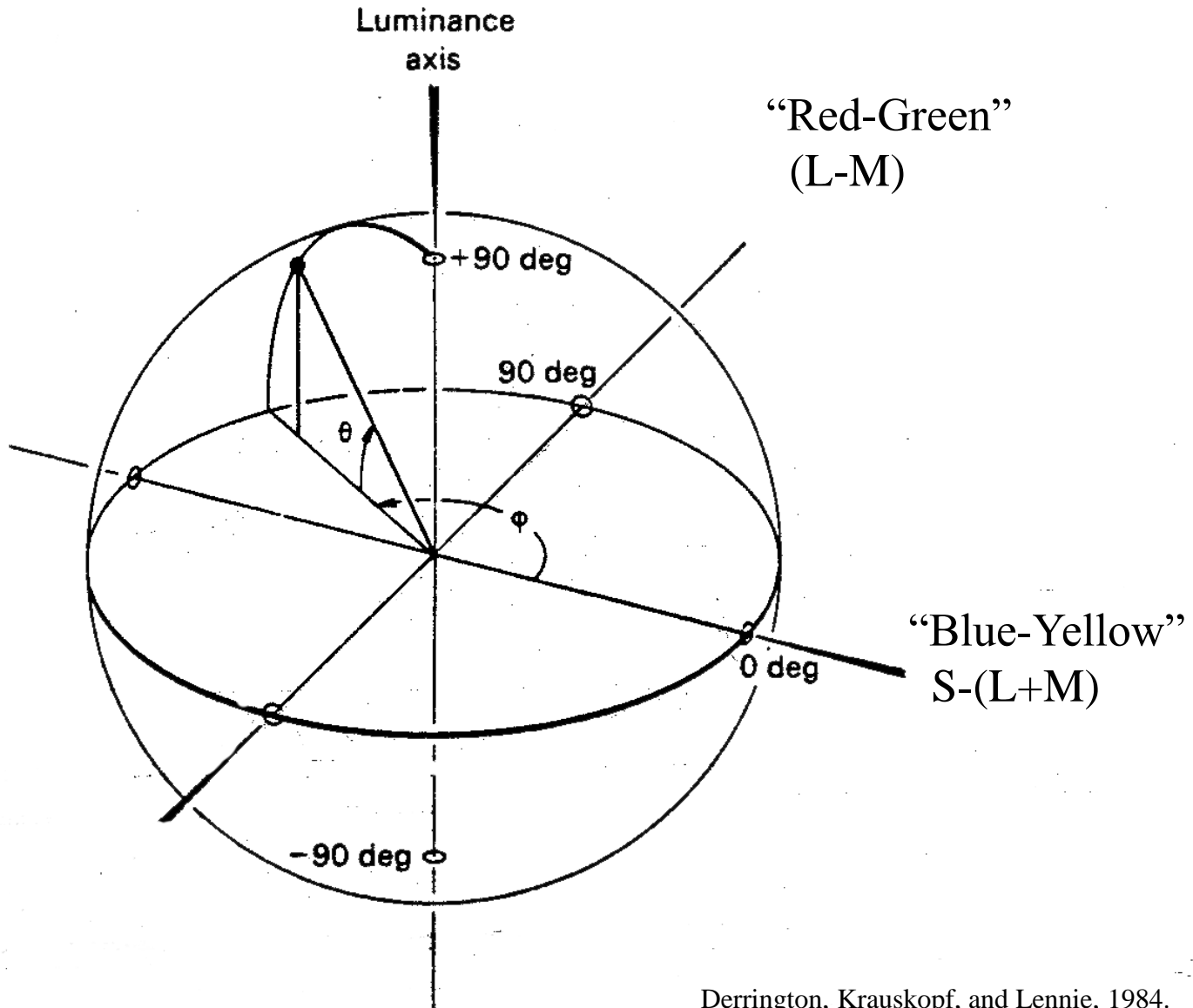
## A M cells



## B P cells

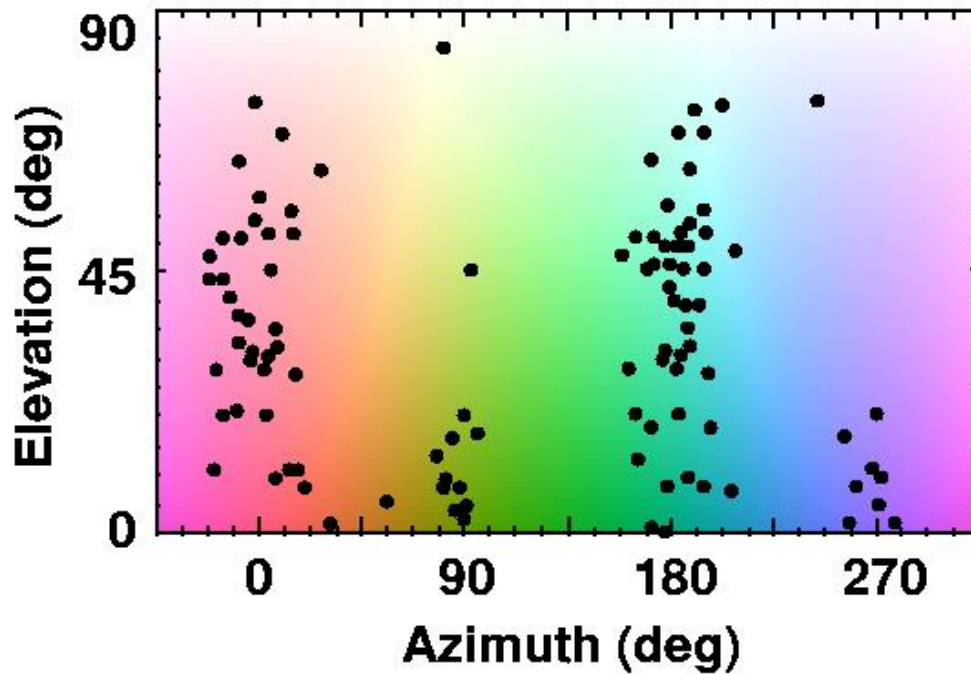


# The “DKL” color space



# Preferred color of pLGN neurones

## Single Unit Recordings (LGN)

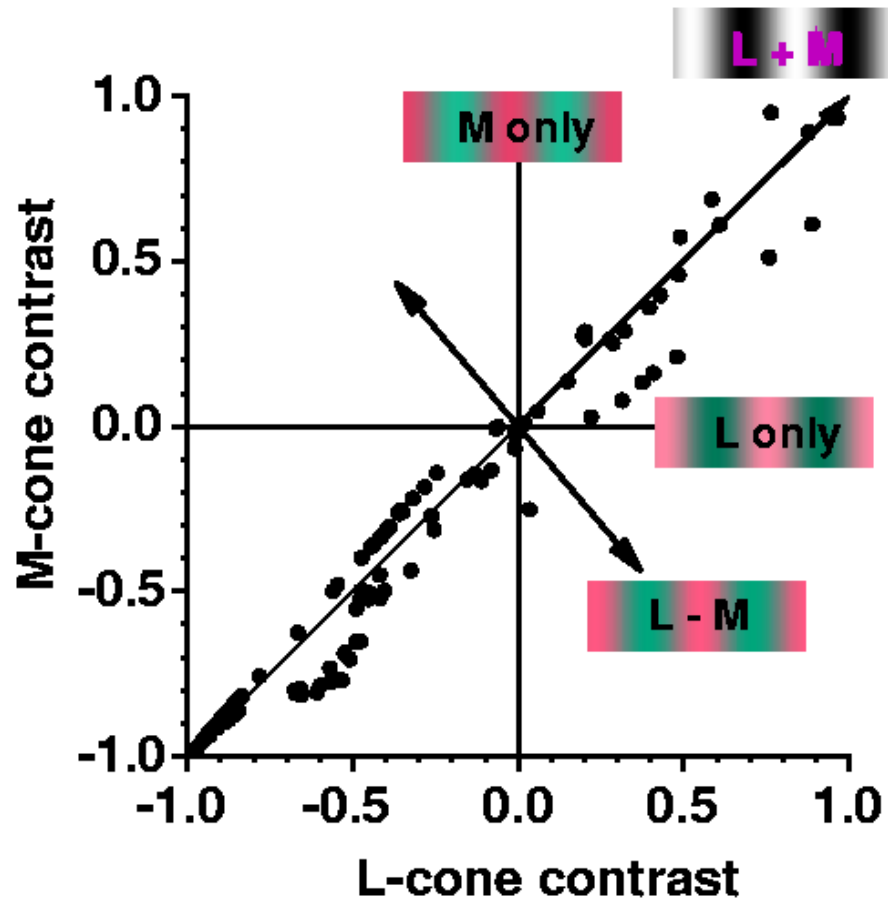


# The world seen through the LGN



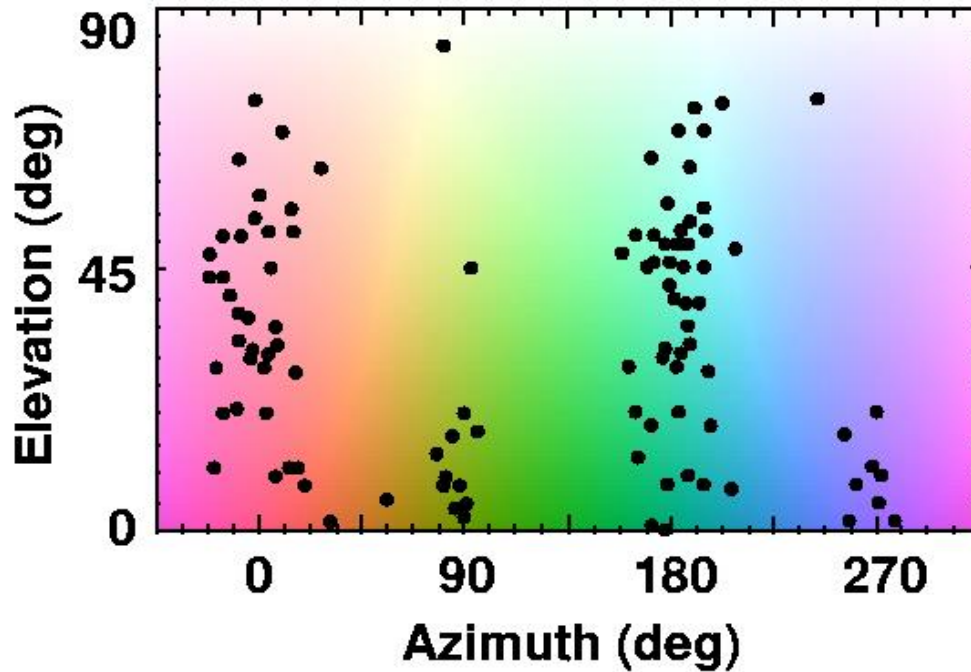


## Color contrasts of natural objects



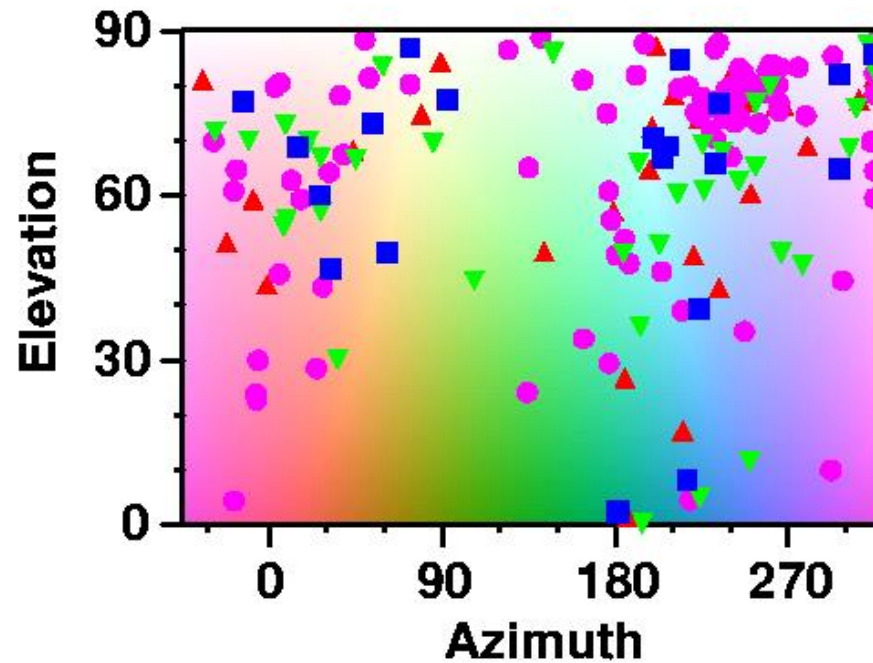
# Preferred color of pLGN neurones

## Single Unit Recordings (LGN)

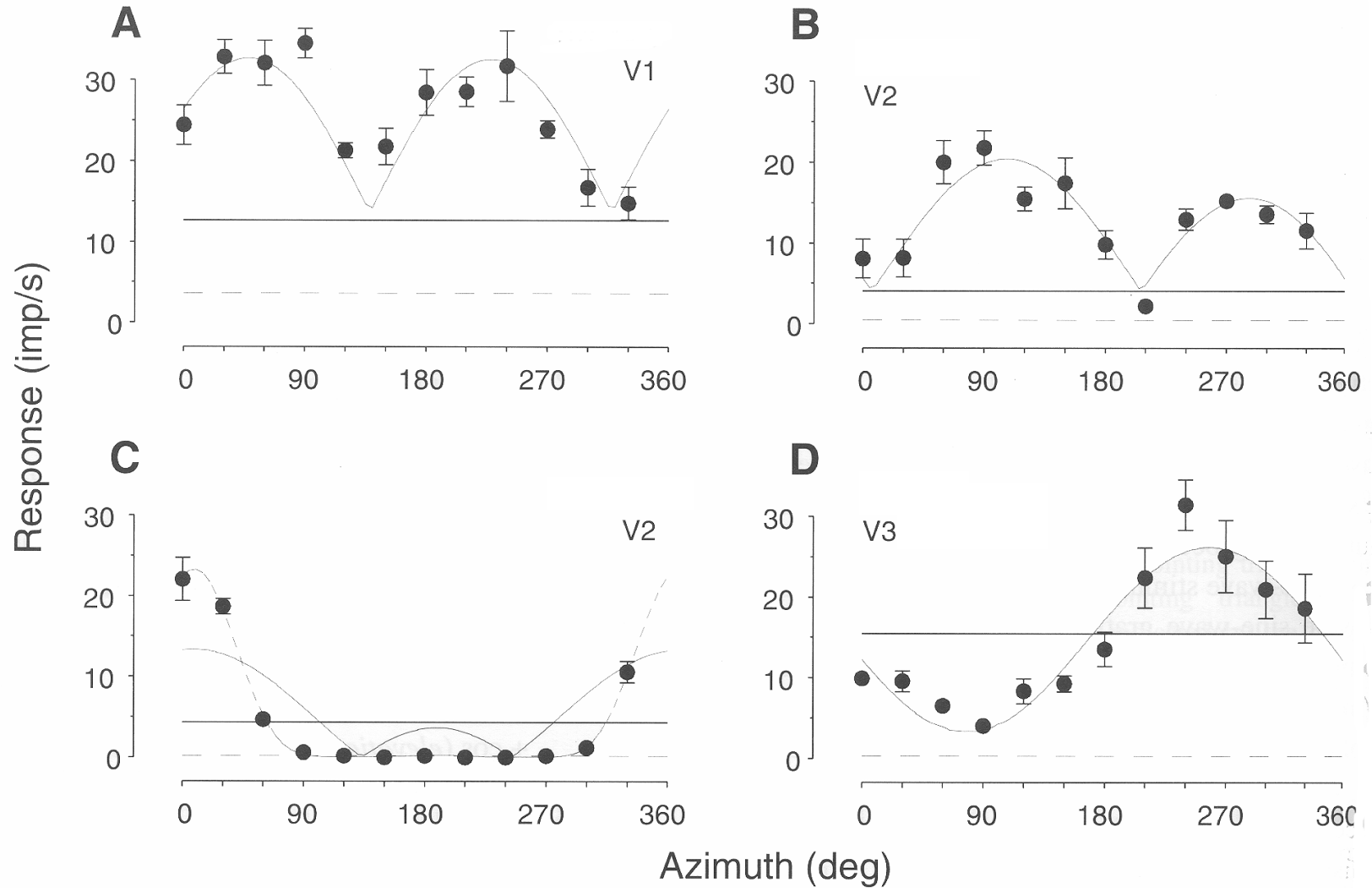


# Preferred color of cortical cells

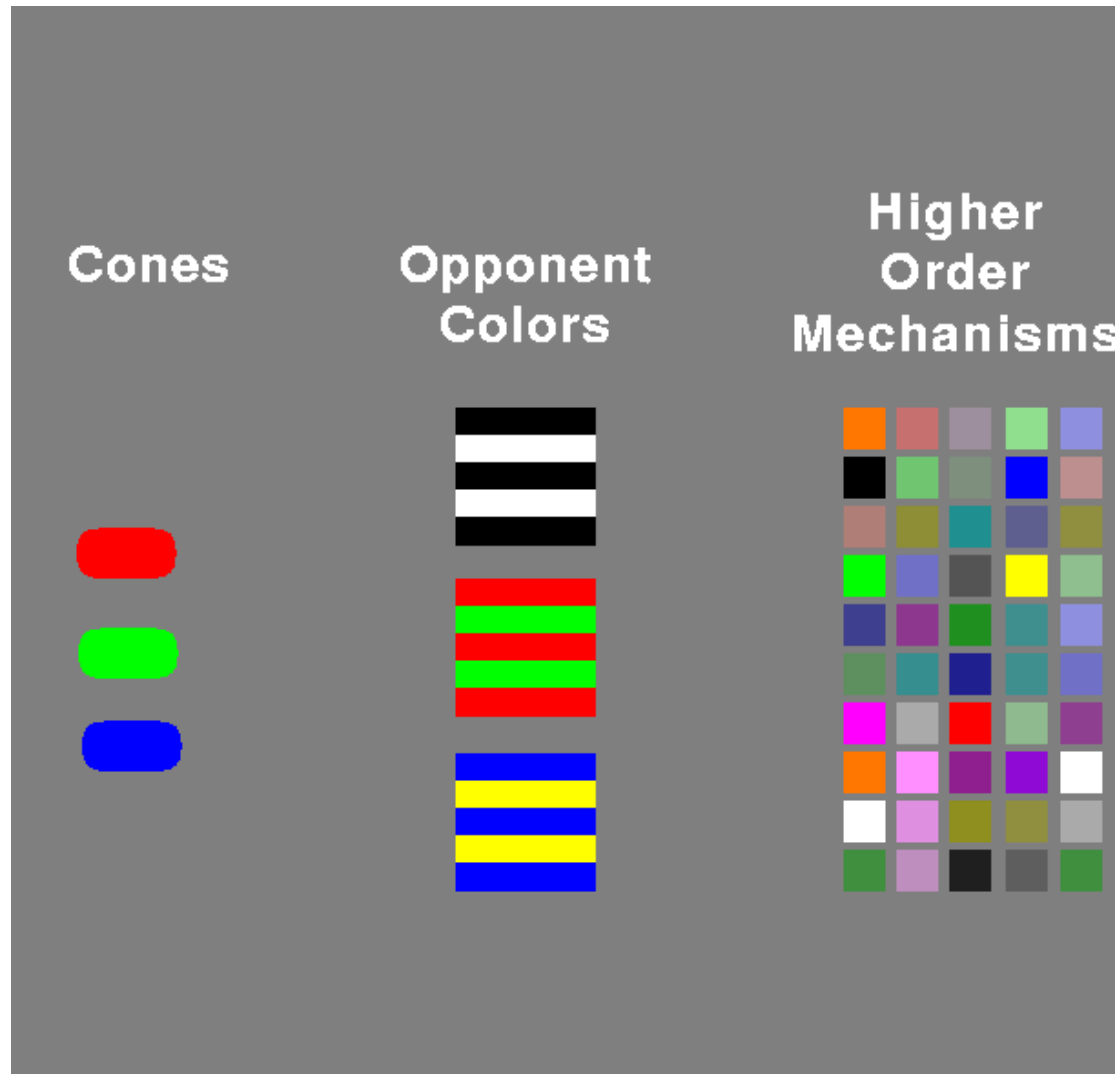
## Single Unit Recordings (V2,V3)



# Examples of cortical cells' responses to color variations



# Three stages of color processing



Later stages:  
Color appearance and  
Color constancy

